

U.S. DEPARTMENT OF AGRICULTURE
GRAIN INSPECTION, PACKERS AND STOCKYARDS
ADMINISTRATION
FEDERAL GRAIN INSPECTION SERVICE
WASHINGTON, D.C. 20250-3630

NIRT HANDBOOK
CHAPTER 2
7-25-05

CHAPTER 2
NIRT EQUIPMENT

| Section Number | Section | Page Number |
|----------------|-------------------------|-------------|
| 2.1 | OFFICIAL EQUIPMENT | 2-1 |
| 2.2 | CALIBRATION | 2-1 |
| 2.3 | NIRT TESTING FACILITIES | 2-2 |
| 2.4 | SETUP | 2-4 |
| 2.5 | EQUIPMENT MAINTENANCE | 2-5 |

CHAPTER 2

NIRT EQUIPMENT

2.1 OFFICIAL EQUIPMENT

Tecator - Infratec Models 1225, 1226, 1227, 1229, and 1241 are approved for official wheat protein; barley protein; soybean protein and oil; and corn protein, oil, and starch determinations. All approved models currently being manufactured are equipped with a hard drive. Hard drive units require official calibrations loaded into the instrument prior to testing.

2.2 CALIBRATION

- a. FGIS approved calibrations are required for official NIRT instruments.
- b. TSD is responsible for maintaining and updating calibrations for official NIRT instruments. You will need to inform TSD if you require calibrations for the Infratec 1241.

For wheat and barley protein calibrations: Contact TSD for information on how to obtain the Artificial Neural Network (ANN) calibration disk. TSD will provide standard slope settings, reference sample sets, and reference sample baseline values.

For soybean protein and oil, and corn protein, oil and starch calibrations: Contact TSD to obtain the approved calibration disk, standard slope settings, and reference sample sets.

- c. A separate Foss ANN wheat and barley protein calibration disk is required for each NIRT instrument. The disk will contain 10 application models named: “Wheat”; “Durum”; “Hard White Wheat”; “Hard Red Spring Wheat”; “Hard Red Winter Wheat”; “Soft Red Winter Wheat”; “Soft White Wheat”; “Barley”; “Six-rowed Barley”; and “Two-rowed Barley”.

TSD provides one soybean/corn disk for each NIRT instrument. This disk will contain FGIS approved soybean and corn calibrations and the current Tecator operating system software. TSD will provide calibration disks with both official calibrations unless otherwise requested.

- d. Standardized instruments are issued the standard slope settings for each grain type they test. Analyze the appropriate Standard Reference Samples (SRS) twice and bias the instruments using the Level II tolerances before the instrument is used for official testing. Replacing the sample cell will require that the pathlength be measured and the SRS tested to check the bias before official testing can resume. Operators must use the standard slope settings, SRS sets, and baseline values provided by TSD.

Note: Infratec Models 1229 and 1241 that are equipped with the variable (adjustable) sample cell do not need to standardize the pathlength. They will use the software assigned pathlength of 18.00 millimeters for wheat and/or 30.00 millimeters for corn and soybeans.

- e. TSD will maintain a master list of all NIRT instruments in the official system and their approved calibration information. Upon request, TSD will forward a list of all instruments and their approved calibration information to the appropriate FGIS field office or official agency.
- f. FGIS field office and official agency managers shall verify the following:
 - (1) The calibration name is identical to that currently specified by TSD;
 - (2) The calibration disk is the current version approved by TSD;
 - (3) Slope values agree with TSD records; and
 - (4) NIRT instruments are configured by FGIS calibration to give wheat protein readings corrected to a 12 percent moisture basis (mb); barley protein readings corrected to a dry matter mb; soybean protein and oil readings corrected to a 13 percent mb; and corn protein, oil, and starch readings corrected to a dry matter basis directly without further calculations.

2.3 NIRT TESTING FACILITIES

Equipment location and environmental factors can affect the performance of NIRT equipment.

- a. Location of Equipment. NIRT instruments must be placed in a location conducive to a dust-free and stable environment. If the NIRT instrument is not located in its own room, all other dust-emitting devices located in the same room must be operated with a functional dust collection system. The NIRT instruments must be protected from drafts, heating and cooling vents, and windows. Also, a vibration-free table is recommended to support the NIRT instrument.

- b. Environmental Requirements. The space and facilities required to perform official NIRT determinations must meet the specifications outlined below:

- (1) Temperature. Temperature affects the stability of NIRT instruments. Each testing site shall install a thermometer near the NIRT instrument(s). **The temperature of the room where official testing occurs must be maintained between 60° and 80°F (16° and 27°C).** Official testing shall be suspended if the room temperature is outside the acceptable range. Once the temperature is restored to the acceptable range, check instrument accuracy using the SRS set and, if necessary, bias adjust the instrument.

If the room temperature changes by $\pm 5^{\circ}\text{F}$ (2.5°C) or more from the temperature recorded during the daily instrument check, retest the SRS and, if necessary, bias the instrument.

- (2) Relative Humidity. **Relative Humidity (RH) must be kept between 20 and 75 percent.** Each testing site shall install a hygrometer (calibrated to ± 3 percent RH) near the NIRT instrument(s). When the laboratory's RH is outside of the acceptable range, retest the SRS and, if necessary, bias adjust the instrument based on LEVEL-I tolerances. Once the laboratory's RH returns to the acceptable range, the SRS need to be retested **only if** a bias adjustment was made while the RH was outside the acceptable range. If necessary, bias adjust the instrument based on the LEVEL-I tolerances. SRS sets collected when the RH is outside of the acceptable range may not be used for the LEVEL-II and higher tolerances. All LEVEL tolerances are listed in section 3.2 for wheat, section 3.3 for barley, section 3.4 for soybeans, and section 3.5 for corn.

FGIS field offices shall periodically check individual testing location(s) hygrometers using a battery powered psychrometer. Before checking the hygrometers, check the psychrometer thermometers when both are dry to determine if they are in agreement. Then check hygrometers against the psychrometer and apply a tolerance of ± 5 percentage points. Repair or replace hygrometers which deviate from the psychrometer by more than 5 percentage points.

- (3) Power Supply. The power for all NIRT instruments shall be supplied by a 120 ± 10 VAC/15-20 amp dedicated circuit. A maximum of two electronic instruments (i.e., NIRT, NMR or Hardness Tester) plus their

associated printers and/or computers may be placed on one dedicated circuit. No other equipment shall be used on the circuit.

NOTE: If a dedicated circuit cannot be provided, a computer grade uninterruptible power supply (UPS) with line conditioner is an acceptable alternative. Before purchasing or installing an UPS, written verification must be obtained from the NIRT instrument manufacturer that the specific model of UPS proposed is compatible with the NIRT instrument. A copy of the verification letter must be kept on file.

A power line conditioner is recommended for use if line voltage variation is a suspected problem. Before purchasing and installing a voltage regulation device, contact the instrument manufacturer to determine which device is best suited for this purpose.

An NIRT instrument may be turned off if it will not be used for at least 8 hours. After turning the instrument on, it must be allowed to warm up at least 15 minutes before testing. Outliers in the "A" or "B" position of the outlier code may be indicated as a result of insufficient warm up.

- (4) Smoke and Dust. Post "**NO SMOKING**" signs in the testing area. Follow good housekeeping practices to maintain a clean and dust-free environment. Use a vacuum cleaner or brush for proper laboratory cleanup. Do not use compressed air for cleanup purposes.

2.4 SETUP

Official testing agencies and FGIS field offices must observe certain guidelines when establishing new laboratories, placing new equipment on-line, or relocating NIRT equipment.

- a. Laboratory Setup. Upon request, TSD will assist official agencies in planning and preparing laboratories for official NIRT testing. Official agency managers must notify the appropriate FGIS field office manager concerning plans for a new laboratory and provide a diagram of the proposed design. The diagram should contain the proposed locations of NIRT equipment, location of major inspection equipment, and description of the power supply. Any additional information regarding the laboratory setup or equipment should also be included. The monitoring field office manager will forward a copy of all submitted information to TSD for review. Upon receipt, TSD will review the information and make recommendations to the official agency manager and monitoring FGIS field office manager to facilitate the laboratory setup.

- b. Equipment Setup. Official personnel shall notify TSD and the appropriate field office when new NIRT instruments are purchased. TSD will provide the necessary samples and instructions to check the accuracy of the instrument(s). Contact TSD as soon as possible because the checkout process may take several days to complete.

When an NIRT instrument is moved to a new location, the instrument must be allowed to reach temperature equilibrium with its environment before performing official tests. Generally, the instrument should sit for at least 2 hours before use after being moved. If the instrument might have been subjected to extreme temperatures during shipment, allow the unit to sit overnight in the new location before operating it.

2.5 EQUIPMENT MAINTENANCE

- a. General.

- (1) Using a brush or cloth, dust out the sample hopper and path at the end of each day.
- (2) Replacement lamps for the instrument are expensive and, therefore, the lamp life should be extended as long as possible. Turning the lamp on and off frequently decreases its life. Turn the instrument off only if it will not be used for a period of 8 hours or more.

- b. Repair of FGIS-owned NIRT Equipment.

- (1) Repair and service of FGIS-owned instruments are coordinated by FGIS personnel presently located at the FGIS Technical Center in Kansas City, Missouri.
- (2) TSD personnel are assigned to assist field office personnel in: (a) maintaining instruments, (b) performing diagnostic tests needed to verify acceptable performance, and (c) performing modular replacement when required.
- (3) Repair Procedures.
 - (a) If an NIRT instrument malfunctions, the designated field office

NIRT coordinator should contact TSD at (816) 891-0446 to report the problem.

- (b) The NIRT coordinator should be prepared to answer all questions regarding the symptoms of the failure (error codes, erroneous readings, malfunctioning display, etc.) and to perform diagnostic tests while maintaining telephone communications with TSD.
- (c) TSD will take one of the following actions:
 - 1 If the NIRT instrument is determined to be field repairable, TSD will coordinate the shipment of replacement parts (boards, etc.) to the field office.
 - 2 If it is not field-repairable, TSD will recommend return of the instrument to Foss. The field office will be responsible for shipping and repair costs. If possible, a replacement instrument will be furnished to the field office by TSD. A written summary of the malfunction should be sent to TSD.
- c. Repair of Other NIRT Equipment. Official Inspection Agency managers must employ only qualified technicians to perform repairs on NIRT instruments used for official testing. Operators must notify the field office NIRT coordinator and TSD when instruments malfunction.
- d. NIRT Lamp Replacement. Infratec models 1225/1226 may be equipped with either a “Bruins” monochromator or a “NIRs” monochromator. Official agencies operating NIRT instruments equipped with the “Bruins” monochromator may obtain replacement lamps by contacting TSD. The defective lamp with lamp holder must be sent to the TSD in order to obtain a replacement lamp. Fees will be assessed based on the hourly rate for repair, plus parts, and handling cost. Under normal circumstances, the total cost will not exceed \$100.00.

If the replacement lamp does not work upon receipt, or if it does work but the Infratec instrument displays an error code (e.g., Error 56, "No light is reaching the detector") contact TSD immediately.

Infratec models 1229 and 1241 are equipped with the “NIRs” monochromator.

Replacement lamps for all Infratec models equipped with the “NIRs” style monochromator must be purchased directly from the instrument manufacturer (Foss). The Foss “NIRs” lamp (model number 1000 8310) cost is approximately \$150.

Note: To determine the type of lamp installed in a 1225/1226 instrument check the lamp style, type of connection, and manner the lamp is fastened to the monochromator. The NIRs lamp is a halogen lamp like the Bruins lamp, but is equipped with a reflector around the bulb. In addition, it has a 2-pin connector which plugs into the lamp housing, whereas the Bruins lamp is hardwired into the lamp housing. Both lamps are located on the rear of the monochromator, however, the Bruins lamp is fastened to the monochromator with two (2) screws, while the NIRs lamp is fastened with three (3) screws.

- e. Equipment Maintenance Log. Information entered into the log is used as a troubleshooting aid for repair personnel and provides the agency with a maintenance history of the instrument. Record any information pertaining to instrument repairs (e.g., lamp replacement) and other relevant information concerning unusual instrument operation.